

REMARKS

This application has been reviewed in light of the Office Action dated June 16, 2004. Claims 1-46 and 48-51, of which Claims 1, 10, 20, 21, 28, 37, 48, and 49 are in independent form, are presented for examination. Claim 47 has been canceled, without prejudice or disclaimer of subject matter. Claims 4, 20, 21, 31, 48, and 49 have been amended to define more clearly what Applicants regard as their invention, and Claims 1, 5, 6, 8-23, 28, 32, 33, 35-44, 46, 50, and 51 have been amended as to matters of form. Favorable reconsideration is requested.

Applicants note with appreciation the indication that Claims 6-9, 13-16, 33-36, and 40-43 would be allowable if rewritten so as not to depend from a rejected claim, and with no change in scope. These claims have not been so rewritten because, for the reasons given below, their respective base claim is believed to be allowable.

Claims 1-5, 10-12, 17-32, 37-39, 44-46, and 48-51 were rejected under 35 U.S.C. § 103(a) as being obvious in view of U.S. Patent 6,229,926 (*Chui* '926) taken with U.S. Patent 5,600,373 (*Chui* '373).

The aspect of the present invention set forth in Claim 1 is a method of encoding a digital image comprising a plurality of pixels. The image is able to be transformed by a discrete wavelet transform (DWT) to a predetermined level of decomposition, and capable of being encoded on a block by block basis. Each block having a specified block size in number of coefficients, in a first and second dimension. The method includes (a) dividing the image into a plurality of tiles, each tile having firstly, substantially a minimum number of pixels required to produce the number of coefficients

in the first dimension of the block at the predetermined level of DWT decomposition. The predetermined level of DWT decomposition is greater than one, and secondly, less than a minimum number of pixels required to produce the number of coefficients in the second dimension of the block at the predetermined level of DWT decomposition. The method also includes (b) selecting a current tile, (c) decomposing the current tile, using the DWT, to one level of decomposition to form a plurality of subbands including a LL, LH, HL and HH subband, and (d) accumulating coefficients in each subband of the LH, HL and HH subbands to form blocks of the specified size, and encoding each block to a bit stream. The method further includes (e) accumulating LL subband coefficients and repeating steps b) to e) until a predetermined number of coefficients, dependent on the specified block size, of the LL subband have been accumulated, (f) assigning as a current tile the predetermined number of accumulated LL sub-band coefficients, (g) repeating steps (c) to (f) until the predetermined level of DWT decomposition is reached, and (h) encoding the LL subband into the bit stream.

Among other important features of Claim 1 is (d) accumulating coefficients in each subband of the LH, HL and HH subbands to form blocks of the specified size, and encoding each block to a bit stream. The step of (d) accumulating coefficients in each subband of the LH, HL and HH subbands to form blocks of the specified size, and encoding each block to a bit stream is performed in a progressive fashion, even while the tile in question is only partially decomposed into DWT subbands. This is seen by noting that the aforementioned encoding is included within the repetitively looping steps (c) to (g). In contrast, the encoding of the LL subband, which is only performed in step (h) is

outside the aforementioned loop. In step (h), the tile in question is entirely decomposed into DWT subbands. That is, the method of Claim 1 performs the encoding of LH, HL, and HH subbands to a bitstream in a progressive fashion over the time necessary to fully decompose the tile in question. By virtue of this method, the “memory bandwidth” is reduced with respect to the memory bandwidth that would be required if all the LH, HL, HH, and LL subbands were encoded together in step (h).

Chui '926 relates generally to the processing and storage of images in digital cameras and other devices, and particularly to a system and method for applying a wavelet or wavelet-like transform to a picture using a transform tile size that is much smaller than the picture and using less working memory than would be required if the transform were applied to the entire picture at once (col. 1, lines 8-15). The *Chui '926* apparatus tiles a captured image, processing the tiles in a predefined order (col. 2, lines 16-17). After each tile of the raw image has been transformed into wavelet coefficients, the resulting array of wavelet coefficients are compressed and encoded (col. 5, lines 22-24). All the tiles in the image are processed, in raster-scan order by applying a wavelet-like decomposition transform to them in both the horizontal and vertical directions, then quantizing the resultant transform coefficients, and finally by encoding the quantized transform coefficients (col. 9, lines 34-38). After all the tiles in the image have been processed, an image file containing all the encoded tiles is stored in non-volatile memory (col. 9, lines 41-43).

As discussed above, *Chui* '926 decomposes the image into tiles (252 in Figure 6). Figure 6 also depicts that the quantization of a particular tile is performed only once the tile in question has been completely “transformed to generate array of transform coefficients”. Accordingly, nothing has been found in *Chui* '926 that would teach or suggest suggest accumulating coefficients in each subband of the LH, HL and HH subbands to form blocks of the specified size, and encoding each block to a bit stream as recited in Claim 1, in which this step is performed in a progressive fashion, even while the tile in question is only partially decomposed into DWT subbands.

Further, the Examiner concedes that *Chui* '926 fails to teach the features of step (d) and cites *Chui* '373 as remedying the deficiencies of *Chui* '926.

Accordingly, Applicants submit that Claim 1 is clearly patentable over *Chui* '926, taken alone.

Chui '373 discusses “calculating a numerical value based upon the sum of the coefficients in the LH, HL and HH components of the decomposed image” (col. 26, lines 54-55). However, the purpose of this calculation is to determine a compression ratio in order to determine whether “an additional pass through the decomposition process [needs to be] performed” (col. 26, line 41-50).

Applicants submit that *Chiu* '373 does not remedy the deficiency of *Chiu* '926 as prior art against Claim 1. *Chui* '373 discusses that “after the thresholding and quantization of the LH, HL, and HH components of the decomposed input image performed in process 42, decision 43 determines whether the desired compression ratio has yet been reached” (col. 26, lines 12-16). As is seen from the disclosure in *Chui* '373,

decision 43 operates only after the entire image or frame of interest has been decomposed to the level in question. Accordingly, no progressive encoding of LH, HL, and HH subbands to a bit stream has occurred. Subsequently, "upon decision 43 returning the result that the desired compression ratio has obtained . . . lossless compression is then performed upon the results of the decomposed and quantized images for the frame, in process 44 of Figure 6" (col. 27, lines 9-14). Again, no progressive encoding of LH, HL, and HH subbands to a bit stream has occurred.

Finally, *Chui* '373 discusses that the compressed video image data is formatted, or coded, on a frame-by-frame basis for transmission or storage, as the case may be (col. 27, lines 23-26). Only at this point in *Chui* '373 is the aspect of encoding discussed.

Accordingly, nothing has been found in *Chui* '373 that would teach or suggest accumulating coefficients in each subband of the LH, HL and HH subbands to form blocks of the specified size, and encoding each block to a bit stream, as recited in Claim 1, in which this step is performed in a progressive fashion, even while the tile in question is only partially decomposed into DWT subbands.

Therefore, even if *Chui* '926 and *Chui* '373 were to be combined in the manner proposed in the Office Action, assuming such combination would even be permissible or proper, the resulting combination also would fail to teach or suggest at least those features of Claim 1.

Accordingly, Applicants submit that Claim 1 is patentable over *Chui* '926 and *Chui* '373 , whether considered separately or in any proper combination.

Each of the other independent claims, Claims 10, 20, 21, 28, 37, 48, and 49, recites features similar to those discussed above with respect to Claim 1, and therefore are also believed to be patentable for reasons substantially similar as those discussed above with respect to Claim 1.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are, therefore, believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention. However, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our below listed address.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Ronald A. Clayton", written over a horizontal line.

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